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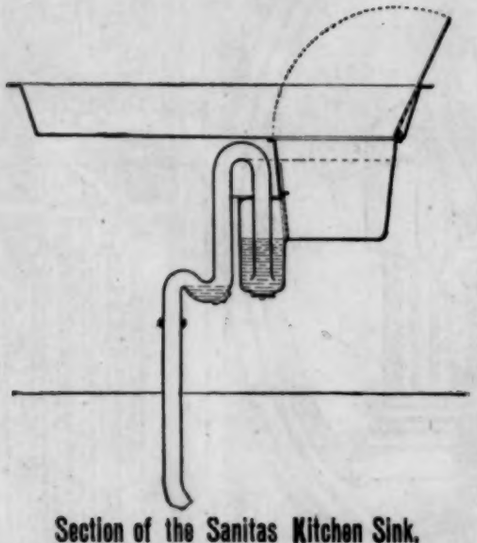
(Gelatine Print issued only with Imperial Edition.)
Santa Paula Academy.
Methodist Episcopal Church, Seabright, N. J.
Church of the Atonement, Edgewater, Ill.
House at Jamaica Plain, Mass.
House at Inglewood, Cal.

THE SANITAS Kitchen Sink —AND— FLUSH-POT.



Section of the Sanitas Kitchen Sink.

THE operation of the Sanitas Kitchen Sink and Flush-Pot is as follows: The sink is used in the ordinary manner until the flush-pot fills to the height of the siphon overflow. When this point has been reached, the next discharge of a quart or two of water suddenly emptied from the washing-pan charges the siphon and causes the entire contents of the flush-pot to rush out through the waste-passages, filling them full bore and scouring them from end to end. The solid matter and large lumps of grease will be left on the bottom of the flush-pot, and must be removed by the servant in the proper manner, inasmuch as they cannot possibly be removed in any other manner.

Thus, by the use of the Sanitas Sink and Flush-Pot, all the great annoyances, expenses and dangers arising from the discharge of sink refuse are completely avoided. Moreover, the Sanitas Sink is in most cases much more economical than any other. The Sanitas Flush-Pot is entirely constructed of iron, and is of simple form. The additional cost of the actual flushing apparatus over that of an ordinary kitchen sink is trifling. But the sink contains its own trap, and the cost of trapping is avoided, rendering the sink really no more expensive than an ordinary sink and trap. The Sanitas Sink-Trap is also anti-siphonic, and hence requires no back venting, in which case the use of the Sanitas Sink and Flush-Pot is considerably cheaper than that of any ordinary sink.

The Sanitas Flush-Pot is designed for use either with ordinary iron, soapstone, wooden, or any other form of sink, and is sold either alone or in combination with an iron sink-body especially cut out to receive the flush-pot, as shown in the figures already referred to.

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FOR a good many years it has been our practice at this season of the year to announce our willingness to give to new subscribers for the following year the issues of this journal for the balance of the current year without further charge. This was satisfactory enough to such new subscribers but it had an unpleasant side to it, for the practice seemed to discriminate against our old subscribers who might, perhaps, feel that if any were to be favored with a fourteen months' subscription for a single payment it should be old friends, and not new ones. This has led us to discontinue the practice for this year, and to substitute for it a largess which might benefit all alike. The form we have selected is a photogravure of Axel F. Haig's extremely satisfying architectural etching, "St. George's Fountain, Lubeck," the original copies of which now sell in the market for one hundred and twenty-five dollars. As the term "photogravure" has of late been somewhat misused in America, we must explain that we do not mean a gelatine print, which by some Americans is called by that name, but a copper-plate etching produced by the same process which has made Goupil's photogravures rank so high in the scale of black-and-white reproductions. The work of this plate measures ten by fifteen inches, and it is printed on heavy plate-paper twenty-two by twenty-eight inches, and we can assure our subscribers that both in size and quality the print will be found one that they will gladly provide a frame for. To all prepaying subscribers to the Imperial edition, whether old or new, who make their subscription direct with us this print will be sent without extra charge. Subscribers to the Regular edition who make their subscription direct with us can obtain the print by adding fifty cents to their remittance for a full yearly subscription. Those subscribers to either edition who find it more convenient to obtain this journal through other channels will receive the print on making application to us accompanied with one dollar, while to any one who is not an annual subscriber we will willingly forward the print on receiving the retail price, three dollars. It may be well to take advantage of this opportunity to say to the subscribers to the Regular edition that the fact that there is no margin of profit on what we give in return for their payments prevents our treating them in this case on the same plane with the Imperialists, and also makes it impossible to add the occasional "extras" we would like to bestow on them. At the same time, they should bear in mind that they reap a direct benefit from the fact that all that is published in the Regular is also published in the Imperial edition, and as it is our constant care to keep this at as high a level of excellence as the subscription rate requires, the portion of the journal that is common to both is really better in grade and quality than it could be if we had only the lesser subscription rate for dependence.

WE were very glad to receive Mr. Yost's letter, published in our last issue, as we always are to get any expression of opinion from architects about Convention matters, and, without applying our remarks particularly to him, we will utilize his letter as a text for a more extended comment on the general subject than we could spare room for when the letter was received. In the first place, as to the proportion between the probable attendance and the total membership of the profession in the country, we think that, in placing the number of architects likely to go to the Convention at a hundredth part of all those in the country, we set it too high, rather than too low. At present, we suppose the number of persons in the United States and Canada who are, or pretend to be, architects, is not very far from seven thousand. A hundredth part of this would be seventy, and, after many years of experience of conventions, we do not remember ever seeing half that number present at any business meeting. Occasionally, thirty or forty men can be collected for the closing festivity, but at the meetings where the destinies of the profession are settled, we have, at least in the Institute Conventions, rarely seen, at any given time, more than fifteen or twenty persons who, under the regulations in force for the government of conventions, were entitled to vote. It is very likely that on the present occasion, which is a particularly interesting one, a large part of the Ohio members of the Institute and the Western Association will take pains to attend, and as Chicago is only half a day's journey away, and contains a great number of enthusiastic and public-spirited architects, while Indianapolis and Louisville are still nearer, it is probable that many will come from those cities, perhaps enough to make up an attendance of seventy-five or a hundred; but the very circumstance that Cincinnati is such a convenient place of meeting for so large a professional population will, we know, keep the Eastern men away. We do not think that it ought to keep them away: on the contrary, we should be glad to see them muster up their courage and go to Cincinnati in a body; but, as a matter of fact, the few of them who can afford to spend a hundred dollars and a week's time, in attending the Convention, will say, and do already say, that the Cincinnati and Chicago and Cleveland and Indianapolis men are quite intelligent and energetic enough to be trusted to take charge of the welfare of the profession, and that if the Eastern members had any interests differing from those of the Westerners, which there is not the remotest reason for supposing, the latter would be in such an overwhelming majority that the Eastern men might as well not trouble themselves to go and vote at all. Now, although the Eastern members are perfectly amiable in making this argument, and are, we think, almost without exception, pleased at the prospect of having the Western vigor infused into the administration of the new Institute, we entirely agree with Mr. Yost, that a great national association of architects cannot, and ought not to be carried on by the representatives of any section, no matter how wise and able those representatives might be. Sooner or later, questions will come up in which the architects of one part of the country are more interested than those of another part, and, whichever way the decision goes, one party will attribute it to undue local influence over the Convention, and we shall hear again the demand for separate organizations. As we have said before, our own opinion, which we put forth with becoming modesty, is that Washington comes nearer to being professionally neutral than any other of our large cities, and that for this reason, combined with the other weighty one, that it is the place from which are issued the commissions for erecting all the great national buildings, it would seem to be the best and most natural headquarters for the new Institute; but even with Washington as the usual place for conventions, we think that some sort of representation of members or Chapters at a distance is desirable. Mr. Yost says that no one would send a deputy to eat his dinner for him, and, under the present conditions of life, most men would certainly either eat their dinner themselves, or let it alone altogether; but if the conditions were to be changed, so that half a dozen members of a certain club, who happened to live in the neighborhood, could, by indulging too freely in Welsh rarebit on Saturday night, have all the other members howling with indigestion the next morning, it is tolerably certain that those who lived farther off would soon demand the privilege of having their representatives present on

such occasions, to revise the *menu*, and moderate incautious appetites. It is a club of this latter kind to which the new Institute should be compared. Its acts do not concern those members alone who are present at the conventions, but affect the fortune and reputation of all the members, and, indeed, of all the architects in the country. Among the measures which it will soon be called upon to adopt or reject are some, such as those for securing the licensing of architects, the protection of members from injustice, and the opening of public work to the profession, which will make a difference of very many thousands of dollars in the incomes of the architects of the country. These measures need, in order that whatever is undertaken may be successfully carried through, to be considered in such a way that every member, and, if possible, every respectable architect, shall have an opportunity to express his opinion, and thus be induced to interest himself in the subject, and join with zeal in enforcing the decision. With some sort of recognized representation, this great advantage can be easily obtained, as, on points of importance, local organizations, or even informal meetings, can discuss the subject before the meeting of the Conventions, and instruct delegates. Of course, care would have to be exercised to apportion the delegates fairly to each section of the country, but, if the matter should come up, either at the next, or at any future Convention, as we hope it may, there is no danger that the members will not act with all possible courtesy and fairness, and the importance of having seven thousand, or seven hundred, concurrent votes in favor of any professional movement, instead of seventy, or even a hundred and seventy, which would be about the total of all the voters present at all the Conventions of the Institute since it was incorporated, does not seem to need much explanation.

OUR readers will remember that a controversy took place in the course of the summer in Paris about the right of M. Eiffel to prevent other persons from making and selling pictures or models of his tower without his leave, and, as the property of artists in their works is recognized and respected in France, the decision of the court upon the matter has been looked for with interest. The newspapers on this side of the water seem to have imagined that the question was whether the tower could be considered a work of art, like a picture, so as to be entitled to the protection from copying or reproduction without the author's leave which pictures enjoy, but it appears that the matter was not so simple as that, and the point at issue really depended upon the ownership of the tower itself. By the contract between Eiffel and the French Government, the great engineer agreed to build for the Government a tower three hundred metres high, and, in consideration of this, the Government agreed to pay him fifteen hundred thousand francs, and to let him have the use of the tower until January, 1910, under certain restrictions as to the price to be charged for admission, and the persons to whom he sub-let the restaurant privileges, the sub-letting contracts being subject to the approval of the Government.

WEN months after Eiffel's contract was made with the Government, he made another with a goldsmith named Jaluzot, by which he granted to the latter for six years the exclusive right to the reproduction of the tower in large or small size, and in any materials whatever, and agreed to lend him the working-drawings, sell him the borings and remnants of the metal used in the construction of the tower, out of which Jaluzot intended to make little models, and sell them as being of the same material as the tower. Jaluzot proposed also to make small gold models, to be put in jewellers' windows as an advertisement, and he made a number of agreements with other jewellers for the use of the gold and iron models. Eiffel, moreover, was by his contract to receive a percentage of the price of all goods of this kind sold or rented. About a year after this contract was made, Jaluzot found that a model-maker, Dijeon, was getting out drawings for making a model of the tower, in copper, at one-fiftieth the real size, which had been ordered by one Pasquier, who intended to exhibit it in America in a sort of cyclorama, with a painted background, representing the other buildings of the Exposition. Jaluzot then brought an action against Dijeon and Pasquier for infringement of copyright, and an action of warranty against Eiffel to compel him to make good the loss caused by the infringement. The court, however, found that Eiffel, by his contract with the State, had conveyed to it all his rights and privileges connected with the tower, including the right of reproducing his design; that the concession given him in return comprised the right of admitting visitors to the tower and of sub-letting the restaurants, but did not convey back to him the copyright of his design, which, therefore, now belonged to the Government, and thus to the public. In selling, therefore, the exclusive right of reproducing the design to Jaluzot he sold what he did not own, and the sale was, consequently, void, but the court held that he was bound to make good to Jaluzot whatever damage the latter suffered through the mistake. Meanwhile, Pasquier had brought suit against Jaluzot for indemnity for the damage he had suffered through the interruption of his scheme for an American exhibition, and the court decided that he was right, and that Jaluzot should pay him twelve hundred dollars, which Eiffel, in his turn, should make good to Jaluzot, and ordered Eiffel to pay all the costs of all the suits.

NOT long ago a generous philanthropist sent to the Press Committee of the Paris Exposition twenty thousand dollars, with the direction that it should be given as a prize of honor to the most remarkable work shown in the exhibition. The principal competitors for the prize were the Eiffel Tower, Edison's phonograph, the Girard & Barré hydraulic sliding-railway and the Machinery Hall. After a rather exciting discussion, the prize was, at a recent meeting of the Committee, awarded to the Machinery Hall. As a considerable number of persons were concerned in this work, it was voted to divide the money among them. The architect, Dutert, was given four thousand dollars; Contamin, the engineer, three thousand, and the assistant architects and engineers, Charton, Pierron, Deglane, Blavette and Hénard, six hundred dollars apiece. The remaining ten thousand dollars was reserved for the workmen who were concerned in the execution of the great building, and the directors of the great Cail and Fives-Lille establishments were requested to send to the Committee the names of those of their men who had it particularly in charge.

WE take great pleasure in mentioning that Mr. Charles Follen McKim, the senior member of the well-known firm of McKim, Mead and White, of New York, has put twenty thousand dollars into the hands of Professor Ware, of the Architectural Department of Columbia University, to be used, under the direction of the Trustees of the University, as a fund for the perpetual maintenance of a travelling-scholarship, or fellowship, for the benefit of the graduates of the Department of Architecture in that institution. With the travelling-scholarship already founded in that Department by the Trustees of the University, in commemoration of the generous kindness of Mr. Schermerhorn, whose gift created it, and long helped to maintain it, the McKim benefaction will render the Columbia Architectural School by far the most richly endowed, as regards incentives to emulation among its pupils, of professional schools in this country, and it is much to be hoped that the large, and constantly increasing number of thoroughly educated men who receive its degree will utilize their unrivalled advantages to the credit of themselves and the profession, at the head of which, so far as training goes, they ought hereafter to stand. It is interesting, and at the same time gratifying, to observe how fond and proud architects whom fortune has favored almost always are of their profession, and how wisely and generously they contribute toward the advancement of the art which they have practised with so much labor, and, usually, with so many disappointments. With men in many, perhaps most other callings, the first thought, when circumstances place them unexpectedly beyond the need of daily toil, is to "sink the shop," to shun their late associates, and try to forget the career to which they have devoted their best years; but architects seem almost always to regard an increase of income as an extension of their means for learning more of their art, and, if they can afford it, for helping others to do the same. It may be a satisfaction to some of them to know that the generosity of a professional man is much more valued than that of a stranger by young men in the same profession, and the high regard which students feel for the more eminent architects will be greatly strengthened by the thought of the noble generosity of the latter toward them in return.

THE SAFE INSTALLATION OF ELECTRIC WIRES.[1]

The Gothic and the Renaissance.

WHEN the notice from your Secretary containing the news of my selection as a member of the committee to prepare a paper on Topic No. 3, "How can electric wires be run into buildings so as to insure safety from fires, also the best insulation for the same," was received, my first impulse was to immediately decline the honor, as I deemed it next to impossible to prepare such a paper unless it were filled with electrical terms and phrases that would tend to befog the whole subject. While the Association assembled here will compare favorably with any like number of representative men in the country, yet they are not supposed to be familiar with the new language invented for the benefit of those who deal with this wonderful force, electricity.

Knowing the great importance of this subject to you, to the great insurance interests, to the owners of property, and, in fact, the entire population of the country, I determined to come here and endeavor to handle the topic in my own way, and, I hope and trust, to your satisfaction and benefit.

The true American fireman never quails in the face of danger in the performance of his duties. The stifling smoke, the poisonous gas, the intense heat and falling walls have no terror for him, for these are dangers to which he has become accustomed. He has braved them all too often to fear them. But man, in his desire to enlist all the force of nature in his own service, has recently succeeded in capturing that wonderful and mysterious force, "the electric fluid," and has succeeded in converting it into a fairly good servant, when kept within proper bounds. As yet the tendency of the current to leave the path chosen for it and to take other and shorter ones has not been entirely overcome. Like the river that overflows its banks, it is too apt to cause damage to property, or injury, and sometimes loss of life, to persons unfortunate enough to stand in its path. With this mysterious force racing through the air above, the earth below, and entering stores, factories and dwellings, doing our work, furnishing light and conferring other innumerable blessings on the human race, for which we are duly thankful, there are attendant dangers that have not been entirely removed.

It is the desire of some people to magnify these dangers many fold. Unfortunately, the newspapers of the country have done more to misinform the public on this subject than all others combined. It is to be regretted that this should be so, as their power for good or harm is almost unlimited. Owing to the conflicting stories regarding the danger of high-pressure currents, I believe the firemen cannot be blamed if they look upon the conductors that run over, in front of, behind and into our buildings for the purpose of furnishing light and power as the soldier does upon the wily foe who would draw him into ambush and slaughter him without mercy. Under these circumstances, they cannot be blamed if they hesitate to mount the ladder raised among wires, or to secure a foothold upon the roof covered with the same, when they believe them to be death-dealing, and that it would be inviting certain destruction to come in contact with or in close proximity to them. "Knowledge is power," and, while this lack of knowledge of the nature of the electric current prevails among you, it must result in a certain amount of demoralization in your ranks when coping with your natural enemy, fire, in the presence of this new force, the danger of which you do not know how to avoid, not knowing just where it exists and to what extent. There is really nothing mysterious about the electric current, and there is no reason why the average citizen cannot fully comprehend the laws governing it. It is not necessary in this paper to discuss the various methods of generating the different forms of electricity. Most of you are more or less acquainted with the weaker currents produced by chemical action in the battery in connection with the fire-alarm telegraph. But it is my purpose to deal only with the more powerful currents used in producing light and power.

The bright, dazzling light seen at the points of the carbons of the arc-lamp, and the less brilliant light produced by the slender filament of carbon in the small glass globe of the incandescent lamp, is due to the conversion of the energy of the steam-engine or water-wheel through the medium of the dynamo-electric machine. This is no more mysterious than lifting water from the river or reservoir and forcing the same through long lines of hose to be directed by you upon the fire, this, also, being a conversion of the energy of the steam generated in the boiler of the steam fire-engine into useful work at a most opportune moment.

I am going to assume that I am addressing a body of men who are entirely unacquainted with electrical subjects, and will try and avoid as much as possible the use of technical terms which are meaningless to all but those engaged in electrical pursuits. First, I will try to explain the few electrical terms which I shall have to use by comparison with synonymous terms with which all of you are familiar.

There are two methods for supplying water to towns and cities for domestic use and for extinguishing fires, *viz.:* the gravitation and the direct pumping systems. In either system, the efficiency of the same for the purpose of extinguishing fires is determined by the pressure in pounds per square inch, or, in other words, the pound is the unit of pressure on the street-mains, service-pipes and on your leading hose. The electric current also flows under a certain head of pressure in order to do its work. As the pound is the unit of pressure in the case of water and steam, the volt is the unit of pressure in the case of the electric fluid. The gallon is the unit of measure for the quantity of water pumped by a steam fire-engine or flowing through pipes. In like manner, the ampère is the unit of measure for the quantity of electricity flowing through a conductor, an electric lamp or a motor.

As you all know, a certain amount of the energy developed in the steam fire-engine is wasted, when throwing upon the fire, in overcoming the friction of the hose, and the greater the length of the line, the greater the amount of loss from this cause. In like manner, the best-known conductors of electricity offer more or less resistance to the passage of the current. The unit of measurement of the resistance is the ohm. If you bear in mind these three terms or units and their application, it will aid you very much in arriving at a perfect understanding of the subject under discussion.

I will begin my illustration of the dangers of high-potential electric currents and of where they do or do not exist, with the simple series or arc-light current. In doing so, I will compare the dynamo to the steam fire-engine and the conducting wire to the line of hose. If we place an engine at a cistern of water, drop the suction therein, then lay out one, two or three thousand feet of leading hose, start the engine up and cause it to run at a good rate of speed, the pressure gauge will indicate in pounds the strain which the water exerts on the same. This strain or pressure, as you are aware, is greatest next the pump; midway between pump and the open butt it is only one-half as great; three-fourths of the distance it is only one-fourth as great as at the pump, and at the butt it will drop to zero. Were water as elastic as air and the lighter gases it would be possible to connect the extreme end of the line of hose to the suction or inlet of the pump, when the conditions would be the same, the water being compressed at the outlet and rarified at the inlet; in fact, a vacuum existing at that point.

These are exactly the conditions that exist in the dynamo, line of conducting wire and lamps run in series. Each arc-lamp offers a resistance of about five ohms to the passage of the current, and to force it across the space between the points of the carbon and maintain the arc requires a force or pressure of fifty volts (pounds). A fifty-light arc-dynamo running that number of lights would exert a pressure of 2,500 volts. This pressure would exist only at the outlet or positive end of the wire, the conditions being the same as those existing in the steam fire-engine and line of hose, only the line of wire, after passing through the lamps, returns to the negative or suction side of the dynamo. There being practically no resistance (friction) to the passage of the current after going through the last lamp, it resembles the rush of water into a vacuum created by the action of the lamp.

We now come to the question of danger to the person and at what points it exists on a circuit from a dynamo with fifty or sixty arc-lights in series. That there is danger from various causes none can deny. That some seek to magnify this danger and others unwisely seek to lull the public into a sense of false security by saying that no such danger exists is too true. I do not propose to array myself on the side of either one of these parties, but to occupy a middle position and what I believe to be the only safe one.

As the greatest pressure on a line of hose is at the outlet of the pump, in like manner the greatest pressure in voltage is at the positive pole (outlet) of the dynamo. If the hose is laid in a circle and returned to the reservoir, and a small pipe run from the outlet of the pump and connected to the coupling at the end of the hose, an amount of water proportional to the size of the pipe and the friction or resistance of the hose will flow through this new passage. In like manner, if a short wire of the same size as the line wire be connected to the terminals of the dynamo the entire current will pass through it, while none will traverse the main conductor and lamps. Should the short wire be so small as to offer, say, the same resistance as the

[1] A paper read before the National Association of Fire Engineers at Kansas City, September, 1889, by William Brophy, Inspector of the New England Insurance Exchange and published in *Fire and Water*.

lamps and main conducting wires, then one-half the current would pass through the former and the same amount would find its way through the latter.

The amount of current required for a circuit of fifty 2,000 candle-power lamps is ten ampères (gallons). The same would be required for one lamp, consequently five ampères would pass through the short wire and five through the lamps. The average resistance (friction) of the human body is about 2,500 ohms. The resistance of fifty arc-lamps is 250 ohms. If a person were to take hold of the wires at the connection with the dynamo one ampère would pass through his body and nine through the lamps. The body of the man offers ten times the resistance that the fifty lamps do, and, consequently, one-tenth of the current passes through his body, the remainder going through the lamps. I believe that a person in this position would be severely shocked if not instantly killed. No well-informed life insurance agent would care to insure a man for the ordinary amount of premium were he to declare his purpose to indulge in such practises. As I said before, the greatest danger lies here, and contact with the outgoing and returning wires would result disastrously to any one.

I will now assume that a person can place himself in contact with the conducting wire midway between the line of lamps and the dynamo, or that the current passes through twenty-five of the lamps before reaching him. Now, if on the other hand, he could touch the negative pole of the dynamo, one-twentieth of the current would be diverted through his body, while the other nineteen-twentieths would pass through the lamps. This also would be a dangerous experiment to undertake, yet not so dangerous as the other one.

I will now assume that the wire is looped into a store in which are placed five lamps, the combined resistance of which is twenty-five ohms, and the electro-motive force in volts is 250. In this case a person could grasp both wires, where they enter and leave the building, without danger, the resistance of his body being 100 times greater than that of the lamps. All this goes to show that the electric current, like any fluid, will follow or flow through the easiest path; and where the human body comes in contact with a conductor that offers greater, equal or considerably less resistance than the person, death or serious injury is sure to follow. If the bare wire is grasped with both hands at any point, and should the wire be broken between the points of contact, death will be the result. You may wonder why it is that so many deaths are reported of persons who, through accident or ignorance, come in contact with electric-light wires, when the conditions just named do not exist. In reply I will say that such conditions do and must exist in all cases where accidents of this kind occur, although the published account does not make it appear so.

Water seeks and finds its level at the ocean, which we may call the zero point. Electricity finds its level at the earth, which we call its zero point in the matter of resistance. The resistance of all electrical conductors is in proportion to their size, decreasing as their cross-section increases. The earth, being infinitely larger than any other conductor, offers practically no resistance or obstruction to the passage of the current. The constant tendency of the current is to seek the earth, so when connection to "ground," as we call it, is made on any two points of an electric-light circuit, a portion of the fluid will be diverted from the line to the earth at one point, and will return to the line and dynamo at the other. Any one point of an electric-light circuit may be in contact with the earth for days, weeks or months; but so long as the insulation of the rest of it is perfect, there will be no escape of current from it or to it at the defective point. Should a second connection be made to ground at another point on the current, however, a portion of the fluid would pass from the positive side of the wire to ground and return through the same to the negative side at the point of contact before mentioned. I will assume now that these contacts are made nearer the positive or outgoing wire, and equally near the negative side of the dynamo, or inlet, so that no lamp will intervene. The entire current would pass from one of these points through the earth and the lights would cease to burn. In that case the station attendant would quickly know that something was wrong. He would know it as quickly as the engineer of a steam fire-engine would know when the hose burst.

We will now suppose that contact is made through the earth with the circuit as above described, with the exception that contact is made at one of the points through means of the human body. Death would no doubt be the result. The conditions would be precisely the same as if the person grasped the outgoing and returning wires, the earth offering no resistance to the flow of the current. Most of you have heard of death caused by contact with iron wires hanging in the street, which in themselves appear to be harmless. These accidents occur in various ways. Sometimes it is a good citizen who seeks to remove the obstruction from the path of his neighbor whose horse and carriage may be coming along soon: or it may be the young boy impelled by his natural desire to investigate and handle anything he may see, who completes this divided circuit through himself to earth with fatal results. You can see that the conditions in this case are the same as if the two wires were grasped at a point near or at the dynamo. There is this difference, however, between contact made through the ground, or "grounding" the wire, as it is called, and contact made from wire direct or "short circuiting," as it is called. The points of contact with the earth may be on widely separated points of the circuit; but direct contact with points differing widely in pressure or potential must be made at points where the wires come near together as a rule. If the circuit is grounded midway of its length, and again through a person near the dynamo, but one-half the amount will pass through the body which would if the conditions were as before described.

I have thus far dealt only with the arc-light circuit with lamps in series like your fire-alarm boxes, bell-strikers and gongs, where a constant amount of current passes over the line, but under varying pressure. I now come to the so-called transformer or converter system, where the transformers and lamps are run in parallel or in multiple, the alternating current, by some called "the deadly alternating current," being employed. It is the apparatus which produces this current that is proposed to be used for the execution of criminals in New York State. With this system a pressure of one thousand volts, sometimes 2,000, is maintained throughout the entire length of the primary or street circuit. The conductors are of necessity run in parallel lines in this and the lamp or house circuit. To the street or primary circuit are connected the transformers or converters, in which is produced a current of only fifty volts, by virtue of the peculiar action of the high potential alternating current generated in the dynamo. In the iron box or outer shell of the transformer is an iron core built up of thin plates, on which are wound two coils of wire, one about No. 16 gauge, the other, say, No. 6. To the first is attached the primary or street circuit, and to the other the secondary or lamp circuit which is carried to the interior of buildings.

In this system we have a constant pressure at all times, but the current varies in amount with the number of lamps in use. Unlike the series or arc-lamp light system the resistance of the circuit decreases as the number of lamps is increased. The wires might be likened to two canals of unequal level, the water from the upper running through sluiceways, turning water-wheels and emptying into the lower, each lamp and each converter forming a circuit of its own between the two main conductors, each taking its own small quota of current from one and returning it to the other. The main conductors are not one continuous line, like those of the series or arc-light currents. On the contrary, two parallel wires are run out in the section to be lighted, and they are not connected at the extreme ends.

In the arc-light or series system the resistance increases with the number of lights. In the alternating system, with transformers and lamps in parallel or multiple, the reverse is the case. Every lamp put in circuit reduces the total resistance of the same. The total resistance of a circuit connected to a 1,000-light dynamo on which is placed twenty-five forty-light converters, when the entire number of lights are burning, would be twenty ohms, not including the resistance of the wire in the circuit. With but one lamp in circuit the resistance would be 20,000 ohms. In the first case it is quite evident if a person were to grasp the two main conductors, and this were a continuous current flowing in one direction, no evil effects would be felt, owing to the high resistance of his body and the low resistance of the circuits; but in the second case the reverse would be true, and it would be dangerous to place one's self in circuit by grasping any part of the conductors not perfectly insulated. In this instance, however, we are not dealing with a continuous current flowing in one direction, but with one whose course or direction is changed some 16,000 times or more per minute. A considerable amount of the energy of the dynamo must be used to change the direction of this rapidly moving current, and there must be a considerable increase of electro-motive force or pressure at that instant that is not measured by the voltmeter. This may be partially illustrated by the action of the pressure-gauge on the pump of a steam fire-engine when it is forcing water through a long line of hose. The fluctuation is very marked near each end of the stroke, the increase of pressure being greatest where the piston attains its maximum speed, and least where the direction of motion is changed.

Each transformer is a generator of electricity, as well as the dynamo, but in a different way. The primary current traverses the coil of wire wound on the iron core, and converts it into a magnet that in turn produces an electric current which finds a comparatively easy outlet through the low-resistance lamp-circuit, for the resistance of forty lamps exclusive of the wire is only one and one-fourth ohms, the pressure but fifty volts, and the amount of current forty ampères, or twenty times the amount generated in the primary coil. With one converter in circuit and the forty lamps burning there will be a resistance, not including the line wire, of only 500 ohms, and the joint resistance of twenty-five converters will be but twenty ohms when the entire number of lamps are burning. You will see by this that a person coming in contact with the wires of a 1,000-light alternating dynamo when that number of lights are burning will not be seriously injured because of the relatively high resistance of his body. The current, following natural laws, will traverse the path of least resistance, *viz.*: through the coils of the converters.

With few or not any lights burning on the converters in the circuit the danger is very much increased. I will now suppose that the lamps on the circuits of one or more of the converters are turned off. The resistance of the primary or street circuit increases as these lamps are turned off, owing to what is termed the counter-electro-motive force of the converter. As before stated, the primary current from the dynamo circulates through the coil wound on the iron core of the converter, transforming that, for the moment, into a powerful magnet, which, in turn, generates a current of electricity

which goes through the lamps in the secondary circuit. The course of this current is directly opposite to that of the current from the dynamo. When the lamps on this secondary circuit are turned off the outlet for this current is cut off and it seeks one through the primary wires; but as its course is opposite to the current from the dynamo, it resists the flow of the latter through the converter. I will now suppose that there is but one lamp out of 1,000 burning, which, by the way, is an extreme case. The resistance of the primary circuit would be 20,000 ohms. If now a person should come in contact with the two wires of the primary circuit midway between the dynamo and the end of the conductors he would receive the current from the dynamo as well as the counter-current from the converters on the circuit beyond the point of contact. The current from the dynamo would come from one direction, while that from the converters would come from an opposite direction on the same wire, and both pass through the person, who offers a path of low resistance to the other wire. Then each in turn pursues an opposite course to that from which it came, thus intensifying the terrible shock to the unfortunate being there placed. This, though, is an exceptional case, and one that I might say never occurs, thanks (in this case) to the desire of the human race to get all it pays for and something more. There are always a large number of lights, aside from those intended to burn all the time, that are never turned off, whereby the dangers attending the transmission of alternating currents are reduced and the conditions just named rendered impossible. Nearly always, however, there are idle converters in the circuit which are a source of danger to persons, this danger being happily limited by the low resistance of the circuit when a considerable number of lamps are burning. Eight lamps in the circuit reduce the resistance to the average resistance of the human body, and as the number increases the danger decreases proportionately. I do not in this case include the resistance of the wire, which it requires an increase of from one to five per cent of the electro-motive force to overcome. It matters not whether contact is made directly with the conductors at adjacent points by the person or at widely different points through the medium of the earth, as in the case of series or arc-lighting currents.

No doubt you have read of persons being killed by taking hold of or coming in contact with an apparently harmless iron wire hanging in the air. In all of these cases a "short current" of lower resistance than that of the main is completed through the unfortunate person. In view of the somewhat increased danger attending this system of lighting I would advise, first, that these circuits be so constructed that they can be readily distinguished from the low tension direct system of incandescent lighting and the series or arc-lighting systems. I would also have them under the immediate control of the fire-department by means of cut-off switches, placed at intervals along the entire line, so that the wires could be disconnected from the dynamo at any point where they might interfere with the work of the department during the progress of a fire. Then they could be handled or cut without danger. This same plan can be and perhaps should be adopted with arc-light circuits. It is being done to some extent now in New England.

You may have heard of men who have said that they "have taken a thousand volts from an alternating dynamo." That is a very misleading expression. I am charitable enough to suppose that through ignorance they believe what they say; for I believe no one ever did what they imagine they have done, and lived to tell of it. With a large number of lamps in multiple or between parallel wires, it is next to impossible for one to take the total output of energy of the dynamo. In all of those cases the dynamo was doing a large share of its regular work. You may also have read accounts of accidents which would lead you to suppose that death lurked in every inch of an electric-light wire, and that the current would leave the same to maim and kill unoffending people in a most mysterious manner. Such is not the case. Those accidents never occur without a well-defined cause.

I now come to the important question of the proper insulation of wires. There are several kinds of insulating coverings for electric wire that are all their manufacturers claim for them, *viz.*: the very best that can be produced at the present time, capable of withstanding any electrical pressure required for all present purposes. They add very materially to the cost of wire. The basis of nearly all the best insulation is rubber. There are two causes that naturally deter the careful electric-light manager from investing in the best form of insulation for overhead lines. First, none of it has yet undergone the severe and searching test of time, owing to the comparative youth of this great industry. You are all familiar with the various brands of rubber hose, and know something of the length of time it can be relied on for effective service. Second, a net-work of wires of all grades and conditions is strung in the air above the electric-light mains, the telephone, telegraph, electric-time, district-messenger, private line, the tramp wire attached to fixtures, poles and buildings without permission from the owners of the same, and the miles of "dead" and abandoned wires that are not worth taking down, and are left to the tender mercies of the elements, sooner or later to come down across the best insulated wires, quickly cutting through the covering and opening a path for the escape of the current, causing loss of life may be, or damage to property by fire. Under these circumstances the managers are in a great measure excusable for the continued use of a low grade of insulation so long as they are menaced by these unwarrantable dangers. The insulation most universally used for outside wires is the much-talked-of "underwriters" or painted cotton insulation. It is a very good insulation if kept dry, but when wet becomes an excellent conductor. I would advise you to treat any wire carrying high-potential currents with the greatest consideration when it is covered with this material, and to give it all the territory you can spare when it is water-soaked from any cause. There are other grades slightly better than this, but they are only attempts to produce something cheaper than the higher grades.

Now as to the best methods of carrying wires into buildings. All wires should be supported on insulators such as glass or porcelain. They should not be fastened to the building by wooden cleats. None but the very best insulation should be used on or near iron fronts, and it should not come in contact with the same. Wires should enter the building through glass, hard rubber or porcelain bushings, and they should be separated by a space of about one foot. A cut-out switch should be placed where they enter, such switch to be accessible to the fireman. It should indicate whether or not the current is in the building, and should be an absolute cut-off. This applies only to arc-light circuits.

We now come to the question of danger from fire. I will say right here that when an electric-lighting plant is properly installed, whether the current be furnished from a central station or a dynamo on the premises, the danger of fire occurring from the same is reduced to a minimum. The causes that lead to fires from the arc-light system are very few indeed. The amount of current being constant and far below the safe carrying-capacity of the wires, danger of overheating the same is avoided. Imperfect joints, loose connections, or any other obstructions of this nature to the passage of the current may and sometimes do cause fires, the electro-motive force being sufficient to overcome such obstructions, and in doing so, setting fire to any inflammable material intervening. The arc-lamp itself has been the cause of the greatest number of fires; pardon me, I should say the incompetent, negligent attendant, by leaving bottoms intended to be closed open, or by not removing broken globes when discovered.

Dangers of fire from the direct, low-tension system of incandescent lighting are or may be more numerous, providing they are permitted to exist. The pressure or electro-motive force is nearly constant, and is far below that point considered dangerous to life. The amount of current varies with the amount of light required. In large stations the currents from several large dynamos are sent into common mains or feeders. The current is sufficient in quantity to heat to a dangerous degree, or even to melt the small house-mains down, if for any cause the resistance of the circuit should fall greatly by reason of ground-connections or short circuits. To prevent this, metals of a low fusing point are inserted, which melt long before the temperature of the wire reaches a dangerous point.

Poor insulation and lack of ample separation is another source of danger. In wet or excessively damp places, wires should rest on nothing but insulating supports, no matter how good the insulating covering may be. They should not rest on wood or be fastened under wooden cleats. A safe rule to apply to all wires concealed between floors and ceilings and behind partitions, is to use the same care as would be necessary were they not covered with any insulation at all. The general practice in New England is to use the very best insulation for this purpose, and by ample distance between the wires themselves, and gas and water pipes, to avoid danger from fire.

The transformer or silent dynamo used in the system of that name, has been excluded from the interior of buildings in New England. The reason for this is that the insulation sometimes burns slowly and a considerable amount of smoke results. Should this occur in a dry-goods store, as well as some other establishments, a considerable loss would result from this cause alone, to say nothing of the loss caused by water.

The wires of the secondary or lamp circuit can be touched and handled with safety, as the pressure is but fifty volts, and they are subject to the same rules and requirements as are those from the direct incandescent dynamo.

The pressure in the primary wires leading to and into the transformer exceeds the limit of safety, and when they are attached to or placed in buildings, nothing but the best insulation should be used. The transformers themselves should when attached to buildings, be well insulated by blocks of well-painted wood, porcelain or glass.

SUN-DIAL MOTTOES. — Now, listen to the voice from the tower of Long Sutton Church — "Sunshine for all." That motto sheds a blessing through the air. It is sweeter than sound of church bells; it is at once a canticle of praise and thanksgiving. A sister motto we hear of at Bruges — Bruges of the many shrines, the shining statue, the paintings divine, the musical carillons: "May no hour pass which it is not a delight to remember." But of sun-dial mottoes the most cheerful and serene, the crown, is this:

"I count the bright hours only!"

It is found at Cawdor House, near Glasgow, springing with life after two hundred years; at Bournstream House after nearly a century more. It is on the walk behind Harrow Chapel; it is in Wales; it is in a village near Como, at Campo Dolcino, and in many other places where there have been healthy, happy minds. — *The Gentleman's Magazine.*

THE ILLUSTRATIONS

[Contributors are requested to send with their drawings full and adequate descriptions of the buildings, including a statement of cost.]

HOUSE OF JOSEPH H. WHITE, ESQ., BROOKLINE, MASS. MESSRS. PEABODY & STEARNS, ARCHITECTS, BOSTON, MASS.

[Gelatine Print, issued only with the Imperial Edition.]

SANTA PAULA ACADEMY. MR. ERNEST A. COXHEAD, ARCHITECT, LOS ANGELES, CAL.

THE building is of frame with stone foundation. First floor contains a large assembly-room to seat 100 children with recitation-room adjoining, principal's room, hall and cloak-rooms. Second floor contains three recitation-rooms and store-room. Total cost including heating, $9,500.

METHODIST EPISCOPAL CHURCH, SEABRIGHT, N. J. MR. W. B. BIGELOW, ARCHITECT, NEW YORK, N. Y.

THE church is to be built for $7,500 of washed brick with open-timber roof of yellow pine. The seating capacity is 250 for the church and 150 for the Sunday-school which are so arranged that they can be thrown together by means of screens sliding down into the basement.

CHURCH OF THE ATONEMENT, EDGEWATER, ILL. MR. HENRY IVES COBB, ARCHITECT, CHICAGO, ILL.

THIS church, which stands on a large lot surrounded by oak trees, is being built of mottled Michigan brownstone.

HOUSE FOR COLONEL DANIEL FREEMAN, INGLEWOOD, CAL. MESSRS. CURLETT, CUTHBERTSON & EISEN, ARCHITECTS, LOS ANGELES, CAL.

HOUSE AT JAMAICA PLAIN, MASS. MR. F. W. WESTON, ARCHITECT, BOSTON, MASS.

THE THEORY AND HISTORY OF COHESIVE CONSTRUCTION.[1]

Ladies and Gentlemen,—This honorable Society of Arts has paid me the distinguished compliment of inviting me to describe my knowledge, and what my experience has taught me in regard to the Arc Vault System, which at present I am constructing in the new Library erected in Copley Square.

This construction, to which I am entirely devoted, I shall in my limited way endeavor to explain. Whatever knowledge I may possess on this subject, is not so much due to my researches and investigations, as to the wisdom of my professors in interesting me in the study of the arts and the applied sciences.

I treasure with gratitude the memory of these professors who imbued me with this knowledge, among these gentlemen especially are D. Juan Torras, D. Elias Rogent and D. José Mamjarres.

Though the principal object of my dissertation, perhaps the most interesting and the one which I know to be of the most advantage, ought to be the purely experimental part of the system which I will call "Cohesive System" applied to the vaults called "Timbrel Vaults," I have to ask the kindness of this select audience for some theoretical divisions, and brief words of explanation, because in speaking of the cohesive system in which consists my specialty, I am aware that even to the initiated in the science of construction there might occur objections. However, it must be borne in mind that as the system is applied in the construction of the new Boston Library it is not reduced strictly to vaults neither is it placed in exclusive competition with brick arches, but consists in one complete system of construction, including walls, partitions, floors, staircases, girders, ceilings, etc.

The great and surprising advantage of the vault which we call "Timbrel Vault" over the brick arch we will find equally in walls, girders, roofs, etc.

I do not pretend that this system is entirely new, it is as ancient as the opposite system which we can call the "Gravity System;" but I must explain that the cohesive system was as frequently practised by the ancients as the "Gravity System" but after the "Cohesive System" reached the height of its splendor in the Middle Ages it gradually disappeared in the same proportion that modern civilization and the Renaissance approached. Was the loss due to the fact that in this great constructive age the architects were builders? Or was the disappearance of this form of construction in Europe caused by the loss of the influence of Oriental architecture—an influence that was felt through many centuries, forming this new and great classic era in the art of the Arabs, or rather the Moorish Spanish architects, who know how to create the decorative construction and the constructive decoration in the "Cohesive System," as the Greeks, centuries before, and the Græco-Romans in their style, exemplified in their system of construction by gravity? With these explanations I now enter into the discussion of my subject, which I divide as follows:

1. Historical Part: Ancient, Middle Age, Renaissance.
2. Theory and coefficients of application.
3. Modern applications.
4. Artistic or æsthetic importance.

The first part of Historical, I subdivide as follows:

Ancient Age: Egyptians, Assyrians, Greeks, Romans.
Middle Age: Arabs, Byzantines or Mussulmans.
Renaissance: Italian, Spanish.

Much has been said lately about the vaults, especially the "Timbrel Vaults"; In the first place against their utility and application, and secondly regarding their origin and use. The most erroneous and contradictory ideas have been emitted in regard to this vaulting, as before occurred with the arch, the latter having been credited to the Romans. To-day there are known and studied by exact designs a great number of antique monuments, some extant and others in ruin; we can from these draw truths and base history.

The use of vaults of brick, stone or the timbrel, as well as the arch, is very ancient, and was known before the Romans, who did nothing but improve, making their use general, giving to them an æsthetic character which had not been done before, because the vault and arch had hitherto been used solely as a constructive necessity, where blocks large enough to cover the space could not be procured. Probably for this reason appeared the "Timbrel Arch."

In proof of this assertion allow me to cite the following.

In a tomb situated in the vicinity of the city known by the name of the City of Sepulchres, near the City of Thebes, there in an elliptical vault constructed of brick not burnt by fire. It is 2 metres 59 centimetres in length by 1 metre 42 centimetres in height. Among the hieroglyphics which adorn this monument can be discerned the name of Amenophis; it must then belong to the time of the eighteenth dynasty, dating, therefore, seventeen centuries before our era. This is in regard to the brick vault in general. Another specimen in regard to the "Timbrel Vault:"

In one of the Pyramids of Egypt, at Gizeh, a tomb discovered by Colonel Campbell (See Figure No. 1) forms an arch of bricks not burnt, these bricks measure 0.170 metres by 0.126 metres by 0.050 metres.

In order to give to these bricks the necessary curve it is understood, that they must have been curved before drying them.

The construction plainly shows that the flat brick was used with the idea of decreasing the number of pieces, closing the space with the least possible joints; thus, to give more strength and cohesion to the arch, they placed four rows, one on top of the other, breaking the joints, constituting through this medium an arch without joints (see the "*General History of Architecture*," by D. Daniels).

It is seen by this specimen that the cohesive form was born, like the arch, and is not any particular invention, nor originated by any given civilization, but is only the fruit of necessity, a spontaneous resource of the most ancient times.

This plainly shows that neither the brick vaults, stone vaults, nor timbrel vaults, can be said to belong to any civilization. These circumstances necessitated the creation of them in every country.

[1] An essay on the Theory and History of Cohesive Construction applied especially to the Timbrel Vault, read before the Society of Arts at the Massachusetts Institute of Technology, Boston, October, 1889, by R. Guastavino, Architect.

The Assyrians, encamped between the rivers Tigris and Euphrates, with abundance of clay at their disposal and especially with asphalts and mineral oils improved the manufacture of bricks; using them as a fuel they came to the practical idea of burning the clay, and instead of using the raw bricks they used them burnt. For such purposes ovens were needed; thence the necessity of covering, and closing the spaces without lumber or stone, but with bricks and terra-cotta. Thus the dome and cone shapes that they were using in their ovens were developed.

The ovens for the manufacture of bricks were large domes constructed with brick or tiles of large dimensions (Figure 3), the bricks lying flat and advancing one over the other, about an inch, and in this manner formed the curve (see the "*General History of Architecture*," by D. Daniels, already mentioned.)

The dimensions of the bricks used in the library of the palace of Khorsabad and in the palace of Nimrod were 35 by 32 by 7 centimetres, or 14 x 12 x 2 inches.

The gardens of Semiramis at Babylon, and the subterranean passages under the Euphrates were nothing else but vaults: by this we can plainly see how ancient are these vaults. The Greeks and Romans did not use the brick in a better manner than the Assyrians; but their facilities for obtaining clay and fuel were not favorable, and so these nations were more devoted to stone construction. The Romans had a marked predilection for the use of stone, as is illustrated by the sewers which they left in Valencia, Spain, similar to those in Rome, although clay was plentiful in that country: through these sewers of Valencia a wagon can easily pass. The aqueduct of Segovia is another specimen again showing their predilection for stone; it is a wonderfully magnificent structure, and a model of static equilibrium. When the brick was used, it was only as a small voussoir, as can be seen on the Flavian Amphitheatre or the Colosseum, not only in the primitive works in this building, but when rebuilt at different periods, where they left good specimens of their progress in works of brick, in vaults and in walls, but always in plain brick arches with voussoirs.

The only specimens which seem to have existed as vault work, or "timbrel" of brick placed flat in imitation of the specimens (Number 1, Egyptian, and Number 3, Assyrian) are some that were probably in the Baths of Caracalla. The architect found difficulty in furnishing light to the central part, which could only receive it through the penetrations in the vault. But for this purpose it was necessary to weaken it and it was constructed with brick arches, like those of the Colosseum and others; they had to be given a great thickness and required walls of immense resistance. It seems that the result desired was at last obtained by constructing the vault with bricks on end, or a "timbrel," using I suppose Puzzolana (Puzzoli) cements, which were slow-setting but good, and using centres which supported the vaults until the mortar had set, but of this we cannot be sure.

I will have to mention, since I commenced to speak about the Baths of Caracalla the following paragraph taken from the treatise on "*Vaults and Bridges*," by Samuel Ware.

"The recollection of the solar bath of Antonio Caracalla, in the present age (when we assume to ourselves so much credit for the invention of iron bridges) may serve to abate some of our enthusiasm. It was a circular building 111 feet in diameter, the roof a dome, composed of *copper and brass*."

By the foregoing it would appear that the cancelli were ribs, and the concameratis *plates*, similar to what may be seen in our iron bridges of to-day. From this historic description cited by Samuel Ware, it follows that if the small domes and arches were constructed with "timbrel arches" the large dome was certainly not built in the same way.

The Middle Ages: — The true epoch of the development of the dome was in the Middle Ages, but no specimen of the "timbrel vaults," or with the brick set flat against the centre, is left. We must, however, for several reasons call attention to the construction of the arches and domes in the Arabian epoch, and of the Mussulman in Persia; a country where a new and powerful civilization was already developed, on the spot where the Assyrian left the trace of his ceramic work — a civilization that inspires us to-day under the vast cupola of St. Sophia.

The cupola was the dominant and Oriental line of their monuments, see (Coste: architect, 1840 and 1841, "*Voyages en Perse*"). The Oriental civilization had great influence in the Antique Byzantium. Not only it gives to Byzantines the richness of color and decoration, but the base of new Classic ideas in the architectural arts.

"The Arabic Arts": — The greatest development is in Cordova, Sedilla and Granada, Spain. Under the influence of the beginning of this civilization was due the mode of construction of St. Sophia, the grandest and most finished model of the cohesive cupola. The cupolas of Persia are all constructed over brick walls, and are the continuation of the same wall with the same material.

From the cupola of St. Sophia to the Renaissance were constructed several cupolas on the cohesive principle. The principal of these cupolas were the mosque of Soliman II, and Sultan Ahmet, the Holy Apostles of Constantinople; Santa Maria in Cosmedin, at Ravenna; Saint Mark, Venice, and the Cathedral of Zamora whose cupola is one of the largest and most beautiful in Europe.

After this epoch in the Renaissance, the most remarkable structures are: Santa Maria del Fiore, Chapel of the Medici, Baptistery of Florence, St. Augustine, St. Peter of the Vatican, Rome; the Madonna de la Salute, in Venice; Ste. Geneviève, Paris; St. Paul, London; The Virgin of the Poor, in Valencia, Spain.

Arriving here we think proper to call attention to one important point: all the cupolas constructed, up to the epoch of Constantine, were with brick and concrete in the Arabic style, following the constructive lines without altering the æsthetic forms; and in all cupolas built after Constantine, up to the beginning of the period of Brunelleschi, in Florence, including the dome of St. Paul, in London, the exteriors are not the representation of the interiors. In the last one mentioned, the interior dome or decoration is a hemisphere, the second one is of the same shape as a truncated cone, and the third one is the exterior dome.

The whole does not represent the progress of the art of construction, nor the way to apply æsthetical forms.

This anomaly is due to the fact of the disuse of the hydraulic mortars of the Romans, Arabians and Byzantines, and that the art of manufacturing these materials, which constituted the base of their cohesive construction, was lost. The Byzantines used baked clay and lava of Vesuvius, or pumice-stone in the construction of St. Sophia.

The architects of the Renaissance, especially in Italy and Spain, were greatly impressed by the works of the Romans, Byzantines and Arabians, and wished to imitate their bold construction, but they did not have at hand, either the materials or the skilled laborers; therefore, they employed plaster, and then was carried the "timbrel arch" along the coast of the Mediterranean from Murcia to Valencia, Barcelona and Genoa, and, finally, to Naples. In all these parts will be found remains of the "timbrel arch." This epoch demands great attention because of the many facts it supplies to aid us in this study.

When the architects of the pontificate, in order to give the richness and grandeur called for according to the epoch, took for their models the Roman and Byzantine construction, as already stated, they had neither the material nor the skilled labor, consequently it was impossible for them to imitate, when they had only common air lime and plaster. The first they found impossible to use in constructions similar to St. Sophia or the Cathedral of Zamora, or the Arabian cupolas. About the second they soon found that the unlimited expansion of the plaster, that only stops when fully saturated, that is when it loses its power of absorption, compelled the architects to supply walls of enormous thickness. Besides this disadvantage, when the plaster has arrived at this condition its strength is gone; loosening the bricks, principally where the building was exposed to the weather, or subject to alternate changes of humidity and dryness. In consequence, its use was limited to very heavy walls, and for ceilings having wooden beams and wooden boards, over which were laid the Arabian tiles, if it was a roof, and mortar and flooring-tiles, if it was a floor.

In some cases the "timbrel vaults" were used as a ceiling and floor, having two or three thicknesses of tiles, with plaster, and the haunches were filled with pottery; this pottery was levelled over with rubbish and mortar, finishing with flooring-tiles.

It is necessary to remark that all of this construction was used only in large buildings, such as convents, palaces and churches, where the walls were very thick, amounting to one-third of the full span, and where the character of the building was a guaranty that the ceilings would not be abused, otherwise it was necessary to patch and repair every few years; but in the ordinary building it was only used in small spans, such as 18 to 20 inches between beams, using three tiles, or two courses of their bricks, set flat, over the centre, and in this state it has remained until the present date.

The first time that cements were generally used in modern days, was from 1845 to 1850: from this date commenced the Renaissance of the "Cohesive Construction." The modern Roman cement that Mr. Parker invented, and patented in 1791 and 1796, was so dear, and the conditions of setting were so slow, that its introduction into buildings was much retarded.

This cement in the beginning was called "Parker's Cement," its author called it Roman cement, having the idea that he was reviving the old Roman mortar. The other cement called "Medina," introduced shortly after, had the same defects. Mr. Aspdin on the 21st October, 1824, took a patent for the formula of the celebrated Portland cement.

This cement was given the name by the author, Mr. Aspdin, because when it is good, and is smoothed with the trowel, it is very similar to the Portland stone when it is polished. With this, I conclude the review of this form of construction, the antique and Renaissance, passing to the modern epoch.

As we can observe, all the timbrel arches of this Renaissance epoch, existing in Italy, as well as in Spain, are constructed with plaster material which does not meet the exigencies of good construction, consequently it is natural that no technical academy in Spain or Italy has taken into serious consideration such empiric construction that has a tendency to lamentable accidents. France and England we will not take into consideration, because like the other nations of the North, they have not bricks of the dimensions and conditions for the cohesive form: they have bricks of a small top and bottom surface, that is 4 x 8 inches, when generally the type for the bricks for the cohesive system are the Assyrian bricks, or the bricks of the Orientals, the dimensions of which were about 12 to 14 inches long, 6 to 8 inches wide, and 1 to 2 inches thick.

In Spain where this system has been used, and is still in use on a larger scale than in any other country, there does not exist any treatise or a single work on the theory of this construction, nor a single scientific explanation of this manner of building, not even an empirical explanation which can satisfy curiosity.

Up to the years 1866 to 1868, the professors of the Academy of Barcelona, one of the most illustrious of Europe, and a city where tiles are more in use than in the rest of the world, did not commence to pay any attention to this style, and when at last they did, it was only to comment incidentally on its resistance and its possible utility; but they did not make it a study, notwithstanding the fact that they were constantly walking over floors constructed by this system. So small was its significance to them as a science! On the other hand, this want of attention is explained by the lack of cements proper for such kind of construction. The want of proper cements, and of an invariable brand, on which to base the calculations, was one of the main obstacles which involved the Catalan and Valencian architects.

The works of this character that I have constructed in Spain, as, for instance, the manufactory of Battlo, in the Corts de Serria, where there are employed 2,000 people with 1,000 looms and 64,000 spindles; the other manufactories of Vidal, Muntadas & Company; the woollen manufactory of Carreras; the glass-kiln of Cassademun, with one arch of 65 feet span, and only 10-inch walls, and the cupola of the theatre of the town of Vilasar, 61 feet span, are all permanent and durable buildings, the arches of which were built having the first two courses of plaster, and the others with cement, representing fifty per cent of the construction with plaster, as I used in my first work in this country, when we knew that the excess of plaster is dangerous, if the walls and rods are not stout enough to resist the expansion.

In some cases the risk and danger caused by the irregularity of the materials were so plain that the workmen were afraid, compelling me to remain in the works to inspire confidence and success.

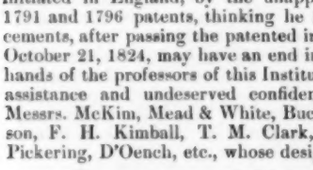
The progress verified in Spain, particularly in Barcelona, in the special construction that we have now under consideration, was due to the studies and teaching of the professors who were debating for several years how to improve their respective specialties, and the way to obtain new practical systems of construction, knowing the fact that the progress of material required a change and progress in construction; but their noble aspirations were restricted having no facilities, and it was necessary to satisfy themselves by recommending the theories of Vicat about the use of cements and other applications well-founded.

Nothing was done about investigating these structures, to which I have referred, and no co-efficients were derived. This only can be obtained when we can depend upon the materials with mathematical regularity, and with powerful apparatus for determining their reliability.

In countries like this where we can find more than twenty guaranteed brands of quick-setting Portland cement of different degrees, and in a country where the clay can be used for those constructions with advantage and regularity of manufacture, and, finally, in a country where we have powerful apparatus, co-efficients can be obtained as we have been doing for the past five years.

From these special advantages it seems these works have culminated in the United States, taking a natural stand in New York and Boston, with specimens that have no rivals in any part of the world for lightness and resistance. We now see that the movement initiated in England, by the unappreciated Mr. Parker, with his 1791 and 1796 patents, thinking he had discovered the old Roman cements, after passing the patented improvements of Mr. Aspdin, of October 21, 1824, may have an end in the city of Boston, and in the hands of the professors of this Institute, but not without the valuable assistance and undeserved confidence of the eminent architects, Messrs. McKim, Mead & White, Buckman & Deisler, R. H. Robertson, F. H. Kimball, T. M. Clark, De Lemos & Cordes, A. H. Pickering, D'Oench, etc., whose designs will always be remembered.

PICTURES AT THE PARIS EXHIBITION.



As no notice has appeared in your columns of the Fine Art, or of the Retrospective Sections of the Exhibition, a few notes upon them may not be displeasing to your readers. Mere descriptions of the subjects of pictures are dry enough, and of little use to those who will never see the originals; but it must be interesting to all of us to know how the different nations stand in relation to one another, and what artists of the several countries are likely to do honor to their native lands. As I have always considered that France stands the first amongst all the nations in artistic matters, it is only repeating what I have already written to say that her show this year is magnificent. But that she is so far ahead of us all, that she seems to be the only country which influences others who ask her aid, and that the good which one finds in certain schools is entirely due to her inspiration, are facts which come out stronger than ever this year. You may walk round most picture-galleries, and if you are acquainted with the painters' work, you may be sure, on looking at your catalogue, to know how each artist will treat the subject. But Frenchmen are imbued with a large amount of originality, and one is always coming upon surprises. Of course, this only applies to the modern schools. Amongst the Centennale collection, one knows, in advance, what to expect of Corot, Dupré, Rousseau and Troyon; but of the host of younger men, one can never guess what they will do next. Perhaps here and there (as in the case of M. Gervex) it were better to adhere to the old times, than to seek originality at the expense of decency, and it is grievous to see such a colorist prostitute his natural gifts in mere pictorial Zolaisms. But offences of this kind are few and far between—*pace*, Mrs. Grundy. There are, of course, many examples of the nude; but nudity, necessarily, is not indecent—indeed, many of the worst pictures are the semi-clothed ones.

But before speaking of modern pictures, it is advisable to notice some of the older men's work. In the Centennale, running through them alphabetically, we find eighteen by Bastien-Lepage, commencing with the portrait of his grandfather (painted in 1874), and ending with the charming little Holbienesque picture of Mme. K., when both he and his sitter were suffering from the same mortal disease. In between these (the last was exhibited, if I remember rightly, after his death) we have, amongst others, our old favorite, "Les Ramasseuses de Pommes de Terre," the "Jeanne d'Arc" (the least successful of all Lepage's work, and the exquisite little portrait of André Theuriet. The ten pictures by Baudry include the beautiful little portrait of M. Henri Schneider, and those of the Baron Jard-Panvillier and Paul Jurjewicz. Passing on we find all Bonnat's best work, and a dozen of poor Bonvin's—snubbed until the close of his long life, he is found here amongst those France does her best to honor. If forty-three Corot's cannot excite people's enthusiasm, it is no use trying to point out the beauty of "Biblis" and the "Bain de Diane," a lovely specimen of his silver mists, belonging to the Museum of Bordeaux. After gazing at nineteen of Delacroix's, we come upon nine portraits by one of the first of modern painters, M. Elie Delaunay. How masterly these are, and how individual in their treatment! M. Paul Dubois is a sculptor, but like M. Falguière, he delights in painting, and proves himself a first-rate portraitiste. Géricault was a powerful painter and a good colorist—witness his study of the backs of some twenty horses standing in a row.

Manet is represented by thirteen of his works, and it is interesting, now that people are beginning to believe in realism, and that M. Claude Manet is patronized by juries and hanging-committees, to see the early efforts of the first impressionist. In spite of Mr. Frith, R. A., and in spite of the experience gained by twenty-eight years art-study, I must fain confess to a certain admiration of Manet even now in my old age. He is provokingly fond of looking at things from the ugliest point-of-view; his "Bon Bock" is hideously vulgar, and his love of violet offends my taste; but I still admire the force with which his little "Fifre" is painted, and his "Toreador tué," would not have disgraced Velasquez—as a mere sketch. Indeed, it was probably the dead figure by the great Spaniard in the London National Gallery (which is such a marvel of foreshortening) that suggested to Manet the idea of emulating Velasquez's *tour de force*. Had he lived another ten years, it is probable that time and the increase of the Impressionists in numerical strength, would have modified Manet's eccentricities. There is a fascination in being the only one to receive the kicks and stone-throwing of the Philistines; but when the kicks cease and persecution is out of fashion, there is little charm in being one of a herd of ignored eccentrics.

Will Meissonier's reputation last? Will he be looked upon as the first of French painters a hundred years hence? Is he now, by independent thinkers? are questions which time alone can answer. But that he does not hold the unique position he did, must be patent to all. There is a certain hardness about his work, and a want of rich coloring, as may be seen in his pictures now on view; but his "1814" is a fine work in its line. Whether as a painter of military life he equals De Neuville, and whether in the master's peculiar line, his pupil, Détaille, does not run him very close, are queries some of us, who are bold enough to confess it, may answer in favor of the younger men. De Neuville was a better colorist, he put more life into his soldiers, and, above all, he touches our hearts. One looks on at that stolid Emperor returning from defeat, with tearless eyes—even the woes of his victims do not appeal to our hearts, and we feel no more sympathy with them than we do for the exaggerated expressions of suffering upon the faces of Baron Gros's warriors; but when we come upon the "Dernières Cartouches," or the "Parlementaire," we feel all the horror of war, and the agony of the wounded sends a sympathetic thrill through us. Look at that poor chasseur leaning against the bed; observe his sullen and hopeless expression—hopeless, because he can do no more in defence of his country, and sullen because he has only to wait until the enemy enters the house and takes him prisoner with his brave fellows.

Amongst the thirteen Millet's is the "Glaneuses," a far better specimen of color and drawing than the "Angelus," though, of course, not its equal in sentiment, which is the great merit of the latter picture. Indeed, it was upon the "Angelus" that Millet's reputation as a poet was founded. M. Jules Breton is also a poet, who poetizes peasant life, and unlike Millet he is a good draughtsman and a fine colorist; but, as yet, he has not won the suffrages of the world for his numerous "Bretonnes" and his "Pardons"; but, then, we must remember he yet lives, and the public prefers putting

its gold into the pockets of the dealer, than into the purses of the painters.

It is with pleasure I greet once more M. Raffaelli's "Petits Anes," that charming little couple standing upon the weed-grown hill. If only Raffaelli could forego black and dirt, how admirable some of his work would be! Let me, in passing, point out the power of M. Roll's "Vieux Carrier," an old man in a white blouse, and a wondrous piece of handling. Rousseau is represented by fifteen and Troyon by ten works, all worthy of study.

The drawings by Barye, Baudry, Corot, Delacroix, Géricault, Millet and Prud'hon, and the caricatures of Gavarni and Daumier are legion; but we must pass them by, and visit the moderns of the Décennale and Foreign Sections.

The only fault which can be found by a carping critic in the Fine Arts class of the great exhibition is in the arrangement. Perfect masters in organization as the French usually are, they have this time failed to exercise their talents. One finds the same names in the lower rooms on the ground-floor (given up to modern art — a sort of second *Salon*, in fact) and in the first-floor galleries, which are divided into the Décennale and the Centennale. This is confusing as one sees a painter sometimes in one place, sometimes in another, and a few, in all three. A man may be in the modern gallery, and yet not considered worthy of the Décennale, or he may be in the latter, but not form one of the select few in the Centennale. Thus Carolus-Duran is in all three; Delaunay is in the two honored positions, and the deceased painters are only in the Centennale. And the plague of it is that if one wants a catalogue, one has to take two volumes.

Very few persons have had the chance of seeing M. Delaunay's work, for he rarely exhibits; but even to those who know his portraits, such *tours de force* as those of "Général Mellinet" and "M. l'Abbé . . . " are a revelation. The former is a mere sketch, the latter is highly finished, but both are specimens of the finest coloring and technique. It is a pity M. Benjamin-Constant did not send his "Justinian" or his "Théodora"; as it is, we must be satisfied with some nine inferior works (to those above mentioned), although the "Passe-temps d'un Kalife" is by no means anything but a fine scheme of coloring. But broad effects and dashing *coups de brosse* upon a large surface are this painter's distinguishing talents; and, unfortunately, his enormous canvas of the "Justice du Chérif" is one of his least interesting pictures. We hail with pleasure one of M. Bonnat's earliest and best pictures, "St. Vincent-de-Paul prenant la place d'un Galérien." The first time I saw this picture, indeed the first time I became acquainted with the painter's work, was some twenty-three years ago when I was buying something in Messrs. Roberson's shop in Longacre. It had just come from Paris to be sent to some London exhibition, and it struck me as a very powerful piece of work. Since 1866 it has been buried in the darkness of St. Nicholas-des-Champs, whence it has been unearthed for the benefit of a younger generation. M. Carolus-Duran shows us one of those charming Velasquez-toned portraits of children which used to delight our color-sense, as well as M. Pasteur and other fine portraits; but it is in the pink and gray coloring of a fair young child that he excels.

How fine, too, are the little portraits by M. Chartran of MM. Mounet-Sully, J. Story, Ch. Lefebvre and Mme. Lambert, and our old friends: Duflos in the *rôle* of Don Carlos, by M. Comerre, and M. Henry Maret by M. Cormon. MM. Dagnan-Bouveret and Dagnan have most of their best works, the latter's "Moulage sur Nature" seeming to me to have gone off in color. It is curious, and, if one knew the painters' methods, it would be instructive, to watch the effect of time on their work: some seem to be as fresh as when first painted, while others have terribly deteriorated. Of the former class, note MM. Montenard's and Olive's landscapes of the south of France. How exquisitely sunny and light! how full of air and seabreezes!

A young painter who makes his mark is M. Friant; *médaillé* first in 1884, he is advancing to the front rank. As one passes round the rooms one meets many old friends: M. Geoffroy's realistic school-children, M. Roll's powerful "Miners' Strike," M. Goeneutte's sad Parisian scenes, M. Heilbuth's charming environs of Paris and Roman cardinals, M. Henner's masterly "Fabiola" and "Mon Frère," M. Monvel's eccentricities, M. Morot's "Reischoffen," M. Pille's "L'ami Benjamin-Constant," M. Perret's Burgundian women, M. Puvis de Chavanne's unhealthy and half-starved victims, M. Rixens's portraits of Delsarte and his cello (as fresh as ever), and M. Vollon's incomparable pots and pans.

Of the sculpture, the water-colors and the engravings it is impossible to write — space will not allow me — but, in passing, it may be well to point out that the separate pavilions of the Societies of Aquarellistes and Pastellistes contain some very fine works. Go from that early home of water-color painting, Great Britain, into the French gallery, and see how far greater the work in the latter is. True, in England many artists *only* work in this medium, whereas the French Aquarellistes are mostly painters in oil, which may account for the greater breadth of treatment in their work. But whatever the cause, the result is a certain freedom of touch and strength of handling which one does not find in the work of the London water-color societies. They are not *modern* in their style. An impressionist run riot is M. Ch. Toché, who rejoices in a pavilion all to himself. He is clever, but, to judge fairly of his work, the room should have been six times as long. Possibly the effect of his pictures might be good, could one stand a quarter of a mile from them; but, hung as they are, his canvasses (notably "Washington Irving's Guide of the Alhambra") have the appearance of having been covered with palette scrapings.

It is difficult, and, writing for an American journal, invidious, to class the foreign pictures; but your readers must not think me a flatterer if I say that, after France, the United States seems to me to come out strongest; my own country certainly does not. Some years ago, I predicted that America, as a country with no art history, was doing the wisest thing in going to the most artistic of the Old World nations to educate itself. Since that time our younger Englishmen have done likewise, and with the best results; but, unfortunately, whereas the United States are represented by their Paris-taught men, Great Britain is mainly represented by the old school of uneducated geniuses, such as Mr. Sant and Mr. Goodall. Of course, others have sent — Mr. Orchardson, Sir John Millais, Mr. Alma-Tadema and Mr. Herkomer; but the two latter are not Englishmen, and there is, unfortunately, a very large proportion of weak sentimentality on view. Spain has a fine show, and disputes the first place with the United States; but Spanish art is mainly the work of a few men, whereas from America many hail. But throughout all the foreign section, with the exception of Great Britain and Holland, all that is good shows the influence of France. Holland has a distinctive style of its own, and not a bad one. Great Britain also shows originality and individuality in the work of Mr. Burne-Jones and Mr. Watts, but whether the originality is of a high order is questionable. If Botticelli discovered the highest aims of art, if the world has learned nothing in the way of drawing and modelling since the old Italian's day except what must be unlearned, then Mr. Burne-Jones's art is of the highest order, for he is simply the admiring disciple of the early Florentines. But if the expression of art has advanced since the fourteenth century, if Titian, Velasquez, Tintoretto, Rubens and Rembrandt count for something in the history of painting, then I fear we must look to other exponents than Mr. Burne-Jones. "King Cophetua" may be an "original" picture, but both the king and the damsel must have been painted from choleraic specimens of the human race, or else they are "idealized" in a sense that I cannot understand. Art ought surely to express nature, but no human nature I have ever seen has been of the color of Mr. Burne-Jones's good people.

But to return to the States. Mr. Bridgman seems to have failed to fill the high place which his earlier work promised, though possibly he is not well represented. Mr. Boggs's landscapes or Paris-scapes are always welcome if somewhat sad and damp. Mr. Dannat astonishes us once more with his open-mouthed Spanish singers, "Un Quatuor." Mr. Hitchcock has exhibited his "Tulips," "Maternité" and "L'Annonciation," a semi-realistic, semi-ideal treatment of an old, world-worn subject. The Blessed Virgin stands as a peasant girl, with a faint *nimbus* behind her head, looking down upon a garden of lilies, from which she learns the angelic message. It is a poetic picture, and certainly an original one, without a spark of eccentricity or clap-trap. True to the life are Mr. Humphrey Moore's Japanese views, but they are not seen through Japanese spectacles, as are so many similar works of European painters. Mr. Pearce's "Bergère" reminds me that his French artistic cousin, M. Lerolle, is not represented in the exhibition, which is a pity. Mr. Sargent's three Velasquez-like children are here, and make one wish that he would return to his early manner. His "Lady Macbeth" was a magnificent bit of color, and many of his late portraits are marvellously lifelike; but for breadth and strength gained without effort, perhaps his three children and their surroundings are his best effort.

M. Madrazo is a Parisian Spaniard, but his work has a certain freshness and grayness that recalls his great compatriot, Velasquez. Few moderns could put together such a harmonious piece of coloring as his Duchesse de Lécera in pink or his Mme. Saly Stern in white; but the painter should guard against a certain tendency towards the coloring of china and enamel painters. M. Aranda is another master who is an honor to his country, both in oil and water-colors; and although M. Martin Rico's views of Paris, Rome and Venice resemble each other rather too much, they are full of light and air.

Germany has very few works, but the few are good. Every one who sees the *Salon* knows the work of MM. Kuehl, Uhde, Leibl, Stetten, Heffner and Liebermann, and the same remark applies to Austria-Hungary. M. Axentowicz's portrait, M. Ernst's "Gardien au Caire" (Pasini-like in its style), M. Pettenkofen's little "Marchande de Volailles" and "Le Marché au Chevaux — Hongrie" are all gems in their several manners. Here, too, we renew our acquaintance with M. Munkacsy's greatest work, the "Christ before Pilate," and those weird and touching pictures by M. Payer of the death of Franklin and his brave companions. Landscapes by MM. Ribarz and Jettel, and the "Veuve du Pêcheur" by M. Schlomka, are also noteworthy.

Amongst the Belgians, the most notable are the "Passage d'eau," the "Vieille Lys" and the "Pic Nic," by M. Claus, who has found out the secret of reflecting light onto his canvas; some marvellous Holbeinesque work by M. Van Hove, "l'Alchimie; M. Verhas's "School Parade" and M. Courtens's "Retour de l'Office."

Great Britain is not well represented, but, besides those already mentioned, one must cite the works of Messrs. Moore, Hook, Forbes, Clausen, Gregory, Hacker, Parton, and the fine portrait, by the late Frank Holl, of Sir H. Rawlinson, Mr. Ouless's "Cardinal Manning"

and Mr. Shannon's "Mr. Henry Vigni." It may be interesting to note that some French painters think very highly of Mr. Burne-Jones's work, and that the generality consider the British section interesting from the point-of-view of individuality. Certainly this is true of a few of the English painters; whether for better or worse they are themselves, and unlike any one else. But whether the originality is gained at the sacrifice of other qualities is a question. Originality is not everything.

In the Dutch section we find Artz, Bisschop, Israels, Kaemmerer, Gabriel, Maris, Mesdag, Klinkenberg and Vos; and in Russia, Harlamoff, Endogouroff, Chelmonski, Lehmann, Loevy, Pau-Riewicz and Marie Bachkirtzeff.

Sweden contains the works of Bergh, Hagborg, Pauli, Meinthe, Wahlberg, Traegaardh and Zorn; Norway, Munthe, Normann, Smith-Hald and Skredsvig; Switzerland, Bieler, Giron and Ravel.

Even the South American Republics, Roumania, Servia, Hawaii and other obscure countries exhibit and are acquiring knowledge at the fountain-head, so that in another ten years we may expect to see many more shining lights. PENGUIN.

FLORENTINE *PIETRA DURA* OR MOSAIC WORK.

DOOR OF THE CHAPEL OF THE CHATEAU TYROL AT MERAN AUSTRIA

HER Majesty's Consul-General at Florence says that the proper technical term for the so-called Florentine mosaics is works in *commesso*. They are composed of delicate slices of stones, carefully cut into shape, arranged and joined together (*commessi*) with a fine cement, and then fitted into a thin slab of marble. The pictures are produced by the natural tints of the stones, the selection of which require great taste and skill. Works in *commesso* are executed in the following manner: After the design has been prepared, the thin slices of stone selected for the various parts are distributed among a certain number of workmen, each of whom completes the portion of the design entrusted to him, the whole subject being subsequently united. The stones, after being cut into the required shapes, are carefully set together with a cement made of wax and mastic (*pece greca*), heat being used to bind them together. Slate is employed to support the work during its progress, and to line it when complete. At each stage the first lining affixed to the separate parts is ground down and a fresh one affixed, so that an even surface may always be secured. When the complete design is fitted into the marble slab prepared for its reception, the whole of the base is again ground down to a perfect plane, and is lined with a fresh backing of slate. The fitting is performed with the greatest care, the edges of the several parts being filed until the exact dimensions have been attained. The whole surface is afterwards polished, so that the lines of juncture are rendered almost invisible. To bind on the lining heat is used, as also for uniting the smaller pieces. The operation is very carefully performed, so that no more cement than is absolutely required should remain between the parts that have been joined together. The first operation of sawing the stones into thin slices, from two and one-half to three millimetres in thickness, is performed by means of thin blades of iron or copper, emery powder giving the required friction. The slices are farther sawn into the shapes required to form the various parts of the design by iron or copper wire attached to bows, and always with the aid of emery. The finest emery powder (*poltiglia*) is used for polishing the surface of the stones, and emery is employed for grinding down the linings. For this purpose the work is placed on a fixed slab of marble or slate, iron plates of various sizes and thicknesses, according to the dimensions of the slab, and having wooden handles, being steadily worked over it by one or two men, as required. Sir Dominic Colnaghi says that it would be interesting to trace the origin of this art, and to follow its development from Classic times, through Siena to the present style of work, which began to be practised about the middle of the sixteenth century.

Portraits, landscapes and architectural views were first produced, but it was soon felt that these subjects were unsuited to the materials employed. Decorative designs and imitations of fruits and flowers, therefore, took their place, and form the most successful subjects of modern works executed in *pietre dure*. It has been doubted whether the introduction of the art of working in mosaic into Florence, under the patronage of the Grand Dukes of the house of Medici, is due to Tuscan or Lombard artists, as it would appear to have flourished contemporaneously in both regions. While, however, it has died out — or nearly so — in Lombardy, it has survived in Tuscany, to become an important branch of Florentine industry. To provide stones for the works in real *pietre dure*, Europe, Asia and the North of Africa have been laid under contribution, and the Royal Factory possesses a large collection of stones valued at some 20,000 lire. Among the principal stones employed are amethysts, agates, the sardonyx and chalcedony, flints and many varieties of jasper, pebbles from the Arno (which generally contain a large proportion of lime) and petrified woods. Among the rocks which are chiefly used for works of decoration are red Oriental, Egyptian and other granites, *verde di Corsica*, labradorite, antique porphyry, green porphyry, Oriental serpentine, jade, basalt, silicious Breccia and *lapis lazuli*. Black marble from Belgium is largely used as a foundation, and slate, as has already been mentioned, is employed as a lining for works in *commesso*. The hardness of the materials employed, requiring patient industry to work them, accounts for the costliness of works in *pietre dure*, of which 75 to 80 per cent is attributed to labor. The commercial articles met with in the Florentine shops are chiefly composed of the softer qualities of calcareous stones, while shells are used for the white and pink tints, and coral is occasionally inserted. The workmanship, design and effect are often excellent, but they are able to be produced at much less cost than the works executed at the Royal Factory, of which the following is a short notice: Although artists in mosaic had been employed by Duke Cosmo de Medici in previous years, the foundation of the Royal Factory of *pietre dure* in Florence may, perhaps, be considered to date from about the year 1754, when some rooms in the Casino di San Marco were assigned for the residence of the masters of the art. The factory was principally founded to carry out the works of the great sepulchral chapel of the Medici in S. Lorenzo. This chapel would appear always to have been intended to receive the monuments of the princes of the House of Medici, and never, as tradition avers, to become the receptacle of the tomb of our Lord, which was to have been conveyed to Florence from the Holy Land by the Druse Emir Faccardin (Fakhr-ed-Din). The slow progress of the chapel enabled the artists employed in the factory to execute other works, which were presented by the later Medici princes, on different occasions, to foreign sovereigns, thus extending the reputation of the factory. Some of the artists appear to have tried their fortunes in foreign lands, and it is thought that a part, at least, of the works in *pietre dure*, executed in the Taj Mahal of Agra, are of Florentine origin. In 1723 a small factory was founded at Naples, which existed until 1860, when it was suppressed; but no rival rose to compete with Florence until the establishment of the Imperial works at St. Petersburgh for mosaic in relief, about the year 1840. The mosaics executed in the factory of the Vatican, at Rome, are of an entirely different character from the Florentine works in *commesso*. On the overthrow of the Grand Ducal Government in 1860, the works of the Medicean chapel were suspended until the beginning of 1883. Since this date about 135 square metres of the pavement executed in *commesso* on a large scale have been completed. The total area of flooring of the octagon, excluding the recesses, is 642 square metres. The completion of the chapel has been entrusted by Ministerial decree to the Royal Factory. The total cost up to the present time is estimated at 16,300,000 lire, or £625,000. The average annual value of the production of the factory is calculated at 52,000 lire, of which about 12,000 represent works sold in Italy and abroad on private commissions, and the remainder in part works placed in the museum of the factory and partly repairs in mosaics, etc., existing in the Royal Galleries of Florence, from which the administration of the factory now depends. The works executed are marble table-tops, panels for furniture, caskets, letter-weights, decorated in *commesso*, both flat and in relief, vases, cups, statuettes, columns and other ornamental works. At the present time, says Consul-General Colnaghi, a large piece is being executed, combining all the different kinds of works — *commesso*, *intarsio*, relief and in the round. The work consists of a large black vase, richly decorated with flowers, fruit, birds, etc., and is the first example of *commesso* work applied to a curved surface. All the work is carried on by hand; there is no machinery, though this is much needed, it is said, in the sawing-department. For about two centuries and a half the production of the Florentine mosaics had remained a monopoly of the Royal Factory, it was not till 1825 that there was an industrial application of the art to small articles of jewelery and ornaments. To effect this, however, the true *pietra dura* had of necessity to be put on one side, and its place taken by calcareous stones and shells, thus allowing the work to be executed at reasonable rates. Between 1863 and 1873, the period when the city was the capital of Italy, there was especially a considerable increase in the industry. Since 1873 a variety of causes — such as the removal of the capital, the cholera (which caused a temporary diminution in the number of visitors to Florence) and changes of fashion — have led to a decrease in the production. The outfit of a mosaicist is very simple. With a small table, a basin of water, a brazier, a vise, some copper and iron blades to be used as files, a bow strung with iron wire, a little emery powder and a few stones already cut into slices, which cost only a few francs, his equipment is complete. — *Journal of the Society of Arts.*

St. Martin's, Ludgate, London. — Still another of Sir Christopher Wren's fine old London steeples is doomed to destruction, that of St. Martin's, Ludgate. The *London Athenæum* is moved to make a vigorous remonstrance against it, specially for the reason that in all probability Sir Christopher designed this steeple with reference to its effect as seen in proximity to the massive dome of St. Paul's, just beyond.

SOCIETIES

AMERICAN INSTITUTE OF ARCHITECTS AND WESTERN ASSOCIATION OF ARCHITECTS.

IN accordance with the preliminary notice of September 19th, the Convention of the American Institute of Architects and Western Association of Architects, for the consummation of consolidation, will be held at the Burnet House, corner of Vine and Third Streets, Cincinnati, Ohio, opening on Wednesday, November 20, 1889.

FIRST DAY.

The Western Association of Architects will be called to order at 10 A. M., precisely, by its President, Mr. W. W. Carlin, who will make the annual address, to be followed by the presentation of reports.

The same routine will then be pursued by the American Institute of Architects, its President, Mr. R. M. Hunt, making the annual address.

The reports of both societies will be held for reference to the incoming Board of Directors.

The proposed new Constitution and By-Laws will then be presented for discussion and adoption.

Immediately after adjournment all members will lunch at the Burnet House as guests of the Association of Ohio Architects, and a drive will then be taken through the suburbs. Should the weather be unsuitable, the drive will be postponed until the next day.

There will be no business transacted during, nor stated entertainment provided for, the evening.

SECOND DAY.

Opening at 10 A. M. precisely.

Further discussion of proposed Constitution and By-Laws, and, on adoption of the same, the Convention will in such manner as it may determine proceed to nominate and elect the new Board of Officers, etc.

Miscellaneous business and the reading and discussion of papers will be in order during the Convention, but not to take precedence of the above-mentioned order of business.

Lunch as on previous day.

The Burnet House has been selected as the headquarters for members attending the Convention, as well as for the place of meeting. A uniform rate of $3.50 per day has been made by the management, who have guaranteed that first-class entertainment shall be given.

Immediately on arrival at headquarters each member will please register, and receive a *souvenir* button to wear during the Convention.

Those intending to be present will please notify Mr. Crapsey at Cincinnati, so that the Local Committee may know how many to provide for.

On the evening of the 19th (the day preceding the Convention), a reception will be given by the Cincinnati Architectural Club in Pike's Hall, where the National Exhibit of Architectural Drawings will be held, and to which reception and exhibit all visitors are cordially invited. This exhibition is intended to be the largest and best of its kind ever held in this country. Responses have been received from all the best offices in the country, and it will without doubt be an occasion of the greatest professional interest, and will be well worthy of an especial visit.

The exhibit being conducted by the Cincinnati Architectural Club, drawings should be sent directly to them.

Railroads included in the territory of the Central Traffic Association and the Trunk Line Association, except the State of Michigan, will carry passengers coming to the Convention at usual full rates, but will return all such at one-third full rate. This does not apply from New York City, either the New York Central & Hudson or Pennsylvania Railroads.

The territory within which the return fare will be granted includes the States of New York, Pennsylvania, New Jersey, Delaware, Maryland, Ohio, Indiana and Illinois, except the portion northwest of a line from Chicago to Quincy.

Those living in New England should purchase tickets to Albany or New York, and at one of these points buy through to Cincinnati, taking a certificate of the ticket-agent at Albany or New York.

Those coming from the Northwest should buy tickets to Chicago, Quincy or St. Louis, or some other point within the territory of the Central Traffic Association, at which points they can secure certificates entitling them to the reduction in return rate.

Purchase your tickets at least thirty minutes before leaving time.

In order to secure a reduction of rates, it will be necessary to follow strictly the following instructions:

First. Each person must purchase (not more than three days prior to the date of the meeting, nor later than three days after the commencement of the meeting) a first-class ticket (either unlimited or limited) to the place of meeting, for which he will pay the regular tariff fare, and upon request the ticket-agent will issue to him a certificate of such purchase, properly filled up and signed by said ticket-agent.

Second. If through tickets cannot be procured at the starting point, the person will purchase to the nearest point where such through tickets can be obtained, and there re-purchase through to place of meeting, requesting a certificate properly filled out by the agent at the point where re-purchase is made.

Third. Tickets for the return journey will be sold by the ticket-agents at the place of meeting at one-third the highest limited fare only to those holding certificates signed by the ticket-agent at point where through ticket to the place of meeting was purchased, and countersigned by the secretary or clerk of the Convention, certifying that the holder has been in attendance upon the Convention. All certificates must be signed by Normand S. Patton, Secretary Western Association of Architects.

Fourth. It is absolutely necessary that a certificate be procured, as it indicates that full fare has been paid for the going journey, and that the person is therefore entitled to the excursion fare returning. It will also determine the route *via* which the ticket for return journey should be sold, and *without it no reduction will be made*, as the rule of the Association is that "No refund of fare can be expected because of failure of the parties to obtain certificates."

Fifth. Tickets for return journey will be furnished only on certificates procured not more than *three days* before the meeting assembles, nor later than *three days* after the commencement of the meeting, and will be available for continuous passage only, no stop-over privileges being allowed on tickets sold at less than full fares. Certificates will not be honored unless presented within *three days* after the date of the adjournment of the Convention.

A. J. BLOOR, Secretary, A. I. A.,
N. S. PATTON, Secretary, W. A. A.,
E. H. KENDALL,
CHAS. CRAPSEY,
Committee of Arrangements.

COMMUNICATIONS

[*The editors cannot pay attention to demands of correspondents who forget to give their names and addresses as guaranty of good faith; nor do they hold themselves responsible for opinions expressed by their correspondents.*]

FREMIET'S STATUE OF JOAN OF ARC.

PHILADELPHIA, PA., November 2, 1889.

TO THE EDITORS OF THE AMERICAN ARCHITECT:—

Dear Sirs,—It may interest your readers to know that Fremiet's last statue of Jeanne d' Arc has been purchased by this Association and is now being cast. The bronze will arrive in this city the beginning of next year and will be unveiled with appropriate ceremonies under the direction of the French societies in this city.

This Association has given permission to M. Fremiet to have a replica made for his native city of Nancy. This will be the only one allowed.

M. Fremiet has made a modification in his new statue, namely, the tail of the horse instead of being a "bob tail" has a knotted and tied tail, similar to the "Colleoni."

Your article is in error in saying that M. Fremiet is past the prime of life. He is still comparatively young and full of vigor. His last groups at the Paris Exposition show that his powers have in no way abated. Yours truly. THOMAS HOCKLEY,
Chairman Committee Works of Art, F. P. A. A.

[THE writer of the articles desires to congratulate the Association on the success that has attended its judicious enterprise. The sculptor, though still hale and hearty, was nevertheless born in 1824, and as he is thus within five years of the Biblical limit of life he may be fairly considered as "long past the prime."]

NOTES AND CLIPPINGS

THE CHICAGO AUDITORIUM.—The foundations of the tower cover 69 by 100 feet, and were specially prepared to receive the weight of 15,040 tons, or about 4,350 pounds per square foot, which was to be imposed upon it. The foundation was excavated to the clay layer on which all Chicago buildings are founded, and on this was built a timber grillage 2 feet thick. On this as a foundation, there was laid a layer of solid concrete, 5 feet thick, and to prevent any unequal settlement of this mass, and distribute the weight equally to all parts of the foundation, there were embedded in the concrete three layers of railway rails, one layer of 15-inch V-beams, and one layer of 12-inch I-beams. But even after these precautions, in view of the well-known compressibility of Chicago clay, it was feared that the great excess of pressure in the tower over that in other parts of the structure might carry the whole tower foundation down and cause cracks in the masonry at the points where the tower walls joined those of the main building. To guard against any possible defect of this sort the architects adopted the expedient of loading the tower foundation with a weight approximating to what it would

have to carry when completed, which weight was gradually removed as the tower walls were carried up above the main structure. Thus far the expedient seems to have been entirely successful and the tower shows no signs whatever of further settlement. Among other noticeable feats of engineering accomplished in the structure were the carrying over the stage of four stories of rooms and two stories of iron rigging-lofts. These are supported by four iron trusses, each having a clear span of 110 feet. The banqueting-hall is carried over the auditorium room by two iron trusses, each of 120 feet span. Besides a great number of offices, the building will contain a hotel, with 400 rooms for guests, and the great auditorium, one of the largest public halls in the country, having a seating capacity of 5,000, which can be increased to 9,000 by throwing the stage into the hall and making extra provisions for the crowd. During the Republican National Convention a year ago there were 11,000 persons in the hall at one time. The whole stage machinery is operated by hydraulic power, as are also the elevators in the portion of the building devoted to offices. There are nine passenger and four freight elevators supplied from tanks on the fifteenth story of the tower, with a capacity of 28,000 gallons. An artesian well, now down to 1,200 feet, will supply the hotel with water. The plumbing work throughout has been supplied with ventilating pipes leading to shafts up which the air is drawn by fans. — *Engineering News.*

Properties of Quicksand. — The properties of quicksand are thus described in the *Mechanical News:* The difference between building sand and true quicksand is most easily explained by comparing building sand to road metal, while the quicksand must be represented by fragments no larger than large buckshot, but shaped like very smooth potatoes. In a word, the quicksand is small and thoroughly water-worn so that every fragment has been deprived of all its angles and fairly well-polished. Its particles are very small as compared with those of the building sand. The smaller the size and the more complete the rounding the more nearly will the sand approach a liquid condition when it is moistened. The first glance at a fairly mounted sample of quicksand under a microscope is sufficient to show that the quickness of the sand is amply accounted for by the innumerable friction wheels which the particles themselves furnish. Sharp or building sand, on the other hand, will show few round corners, many angles, corners, and a general condition like that of broken stone. Sea sand is often unfit for building, even though perfectly deprived of its salt, the reason being that the particles have been worn and polished till they have no more binding powers than so many cobble-stones. It is well to remember that quicksand when dry, if very fine, shows the same properties as a liquid. In holding up the centres of large bridges it is sometimes put into cylinders with a plunger on top of it. It will, when thus confined, hold up the load like a column of water, When it is desired to strike the centres a plug is drawn out of the side of the cylinders, and the sand flows out like so much water. The advantage, of course, is that the sand does not need a packed piston and does not leak out, though the work be prolonged for years. Quicksand when dry and confined forms an admirable foundation, and when wet can be loaded over its whole surface, and give a good support if side openings can be avoided.

Fall of a Neapolitan Palace. — "The disused cisterns of the Naples palaces, when not filled up, are becoming a peril to the city," writes a Naples correspondent of the *London Daily News.* "Whether full of stagnant water or empty," he says, "they are equally uncared for, never re-cemented, and the consequence is that their walls crumble, or the water gradually saps the foundations of the palaces. The frequent bursting of the defective tubes of the new water-works is another source of danger and, consequently, scarcely a week passes without part of some building giving way. Recently, a wing of the fine Palace of St. Severo fell to the ground. It was built early in the sixteenth century by the Prince of San Severo, and restored in the middle of the next century. In 1590 it was the scene of a tragic murder. On the 18th of May of that year, Carlo Gesualdo, the third Prince of Venosa and eighth Count of Consa, murdered his wife in one of its rooms. The many inhabitants of the various floors were saved from a horrible death by a strange accident. The palace door-keeper, taking a sudden fancy for eating a melon at midnight, went down into the cellar to choose one, and noticed the sound of stones continually falling into the disused cistern. Alarmed at this, he opened the door leading to the cistern, and saw that large stones, evidently belonging to the foundations of the palace, were continually falling. At once realizing the danger, he called the *pompieri* and authorities, who ascertained that the water was more than six feet above the usual level, and that it had soaked all the sustaining arches of the left side of the palace, in which large cracks and apertures had appeared. The inhabitants of the palace were roused from their sleep and forced to fly. There was no time to save anything, and, half-dressed and frightened to death, the families, most of whom belonged to the aristocracy, took refuge in neighboring houses. At 5.30 A. M. all were safe, and immediately afterward the firemen were sent away for a little rest, having been at the work of inspection since midnight. Not ten minutes after they had left the palace a frightful crash was heard, and the neighboring houses were shaken. The whole of the left wing of the palace, five stories high, had fallen into the abyss opened by the subterranean water, carrying with it the furniture and valuables. Nothing was saved; nothing had been excavated two days after the catastrophe. The principal sufferers are the Prince of Caramanica and the Duke of Mirelli. The former has all his furniture and the jewels of his wife under the ruins. The latter has lost 150,000 francs in money and securities. The Chapel of San Severo, which contains a famous statue of Christ and others, and was joined to the palace by an archway, is so much shaken that it will be, perhaps, necessary to remove the works of art it contains. This accident has aroused great excitement in the city. The Prefect, Syndic and authorities are indefatigable. Signor Pergara, one of the sufferers, an engineer, has written a letter to the papers, in which he justly demands that a careful and thorough examination of all the buildings of the city should be made, section by section. No one feels safe from a similar mishap. The number of palaces propped by wooden supports, even in the best streets, is very great; every day floors fall in, and loss of life is frequent."

Artesian Borings in Dakota. — The Dakotas are believed to possess the most remarkable artesian belt in the world. There are at least 50 deep wells in the two Dakotas, most of them in the South State. Their depth will range from 450 to 900 feet. The pressure is the most notable fact yet developed. The lowest known is 125, and it runs up to 200 feet. The streams are from 4½ to 6 inches in volume. Such a power and volume is unknown elsewhere. The height of these ranges from 100 to 200 feet. The majority of these wells are so far found in a belt of country at least 50 miles east and west and 400 north and south. But there are good artesian wells all along the line of the Northern Pacific Railroad as far west as Helena, where there is one at the altitude of 4,400 feet, which, from the depth of 900 feet, supplies 60,000 gallons of water every 24 hours. In the Red River Valley, the northeast section of Northern Dakota, there is another remarkable belt of subterranean water, which flows to the surface when tapped at depths of from 50 to 200 feet. Farther south, in the section known as the Coteaux of the Missouri, there is a series of shallow lakes or lagoons, which it is believed from their altitudes may be readily transformed into large and small storage basins. — *Iron Age.*

TRADE SURVEY

A few financiers who are credited with more foresight than many others have unintentionally given out recently that if railroad matters are harmoniously adjusted — whatever that may mean — there will be a boom in railway material of all kinds, and activity in this direction will stimulate activity in many others. It is not necessary to comment largely upon this prediction, as the prophecies of financiers and railway managers are not likely to be of more value than those of ordinary business men. In this particular instance, however, it might be well to note the strong probabilities of such a result. In the first place, an immense amount of capital has for years been kept out of railway investments, because too much mileage was built, too much projected, and such incessant rate wars and disturbances that stockholders and investors, at home and abroad, turned their backs and left it to the railroad companies to fight out their own salvation. From recent indications, it is probable that an adjustment of railway difficulties is near at hand. The trans-Continental understanding is the entering wedge. The immense volume of traffic is making harmony possible, and it is probable that this heavy volume will continue through the winter. Already, Wall Street is stirred with schemes for heavy railroad-building, and not a few of the schemes are well backed. The country can stand more railway construction, and capitalists will probably have a chance to invest their millions in that channel before very long. Another feature deserving of passing mention, is the increasing activity in British and Continental markets of all kinds. Crude-iron has just advanced in Scotland; stocks are declining. Continental iron markets are very active. The small manufactories and shops in Great Britain are crowded with work; ship and marine engine-building is employing more labor than ever before. All branches of industry are thriving. Colonial developments are attracting a great deal of British capital, labor and enterprise, and new markets for British products are being developed. Political economists and writers upon economic questions do not apprehend a speculative advance in any direction, but they are not always wise enough to see below the surface of things. There is some danger of a speculative advance in prices. The facts to be kept in mind are these: Demand is pressing closely on the heels of supply, and in many directions buyers of raw material are placing contracts for delivery of material, beginning January 1, and running three or four months ahead; this is the basis of the upward tendency. It is necessary to keep very close to facts, lest mere theorizing might befog the mind, and suggest conclusions out of accord with practical experience.

There is an extraordinary demand for everything in the shape of tools and machinery. The machinery-makers, large and small, have not been as crowded with work for years as they now find themselves. Locomotive-builders are as busy as during the phenomenal activity of 1882. The makers of hydraulic machinery, heavy machinery for mining and mill purposes, have a rush of orders that will keep them busy until April. The development of new mining properties in the West is attracting a great deal of capital and labor, and creating a demand for an enormous amount of machinery. The machine-shops of Chicago, New York and some localities in New England are full of work for from six to twelve months. The lumber manufacturers are preparing for the busiest winter they have ever known. Stocks of lumber are light everywhere, considering the heavy distribution that has been going on all through the season. Our New England boot and shoe manufacturers are having an excellent autumn trade, and all of them are putting their establishments in order for a heavier output. The electrical-machinery makers are very busy. The coal-producers are beginning to feel the heavier demand incident to the approach of cold weather. The anthracite production is two and one-half million tons below the output to this date last year. The Western mines are producing more than usual. The production of artificial and gaseous fuels to take the place of natural fuel is growing rapidly. Pipe-line laying is being pushed much as railroad construction was pushed seven years ago. The house-building season will soon be over, and the records for the year, when made up fully, will show an excess of twenty per cent over last year, according to reputable authorities. The danger which it is necessary for the rank and file of business men to guard against is that of rushing into an undue anticipation of requirements. If cool judgment can be maintained, the producing capacity will be equal to the emergency. If good judgment be cast aside, prices can be run up to a point that will prove disastrous. This threatened advance will not affect all branches of industry or trade, and those which do not share in it would be seriously injured by the increased cost of raw materials which would be indirectly brought about. These dangers, however, are pretty clearly recognized, and the recognition of them wards off most of the possibility of the advance. The extraordinary expansion of capacity through improvements and additions of new machinery and power of all kinds will in due time equalize the forces at work, and protect both the producing and consuming interests against sudden fluctuations and irregularities in prices.

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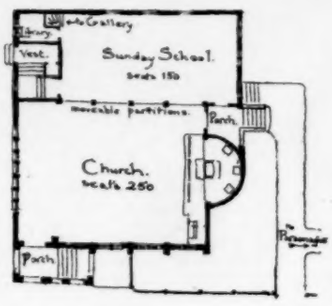

THE NEW METHODIST EPISCOPAL CHURCH AT SEABRIGHT, N. J.

Wm B. Bigelow Architect
52 Broadway, New York.

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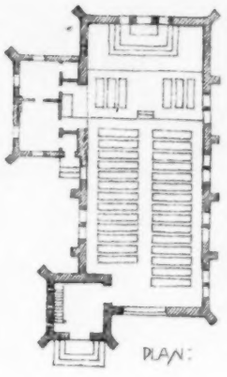

PLAN.

CHURCH OF THE ATONEMENT
EDGEWATER ILL.
HENRY IVES COBB ARCHITECT: CHICAGO.

Heliotype Printing Co. Boston

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